Making Choices

Reviewing Ontario's Long-Term Energy Plan

Ontario

Table of Contents

1/ A Welcome from Ontario's Minister of Energy 3

2/ Introduction 4

3/ Where We Are Now 5

4/ Ontario's Electricity Future 10

- a. Conservation First 10
  - i. Demand Management 11
- b. Nuclear 12
- c. Natural Gas 14
- d. Combined Heat and Power 16
- e. Renewable Energy 16
  - i. Renewables: wind, solar and bioenergy 16
  - ii. Hydroelectric 17
- f. Energy Storage 18
- g. Regional Energy Needs 19
- h. Transmission Planning 20
- i. Innovation 22
  - i. Smart Grid 23
  - ii. Access to Data and Green Button 24
- j. Aboriginal Participation 25

5/ Ontario's Natural Gas and Oil Sectors 26

- a. Natural Gas 26
- b. Crude Oil, Refined Products, and Oil Pipelines 29

6/ Next Steps 30

7/ Glossary 31

© Queen's Printer for Ontario, 2013
Published by the Ministry of Energy
Toronto, Ontario

Disponible en français
Alternate formats of this publication
are available on request from:
Ministry of Energy
900 Bay Street, 4th Floor
Hearst Block
Toronto ON M7A 2E1
Canada

Telephone: 1-888-668-4636
TTY: 1-800-239-4224
Email: write2us@ontario.ca

www.Ontario.ca/ENERGY

ISBN: 978-1-4606-2694-8 (Print)
ISBN: 978-1-4606-2695-5 (HTML)
ISBN: 978-1-4606-2696-2 (PDF)

A Welcome from Ontario's Minister of Energy

Thank you for your interest in Ontario's Long-Term Energy Plan. It's absolutely critical that we have input and advice from every part of this province when we plan Ontario's energy future.

As part of this review, we are consulting with the public, municipalities and industry stakeholders, and engaging with Aboriginal communities and their leaders in every region of the province.

This will be a broad and inclusive look at Ontario's energy needs, including the future of electricity and natural gas. While we hope to receive input on a broad range of topics, I would like to highlight some of the elements that our government particularly looks forward to discussing.

First, this government believes conservation must play a more prominent role in our energy planning. Conservation is the most efficient way to help ratepayers reduce their costs. We need to build a culture of conservation now and into the future.

Second, we would like your views on where and how Ontario should obtain its power in the future. The diversity of our energy sources is one of our greatest strengths.

And finally, since clean energy is essential for our energy future, we are committed to creating a predictable and sustainable procurement program for it.

The government's goals are clear. We want to make our air cleaner, build a modern energy system we can rely on, and help Ontario families and businesses manage their electricity bills.

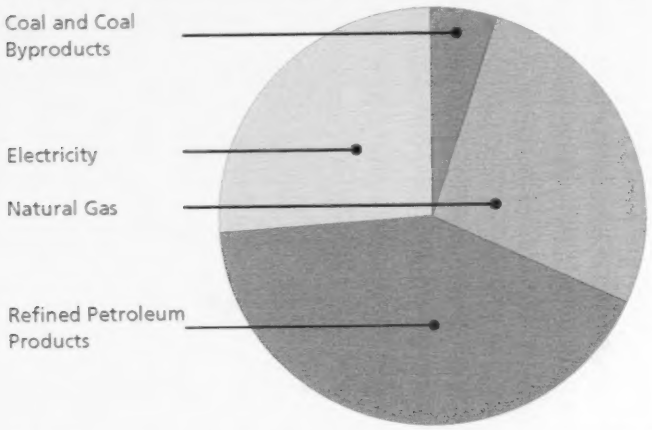
I look forward to working with you as we update Ontario's Long-Term Energy Plan.

The Hon. Bob Chiarelli
Minister of Energy

Introduction

Energy is essential to our way of life. Electricity lights our homes and powers our industries; natural gas heats our homes and generates our electricity; and oil and gas power most of our cars and buses. While Ontario produces enough electricity for its own needs, it has to import the other fuels it needs such as natural gas and oil.

Figure 1: Total 2011 Ontario Energy Use By Fuel Type



Source	Share
Coal and Coal Byproducts	5%
Electricity	26%
Natural Gas	27%
Refined Petroleum Products	42%
TOTAL	**100%**

Source: Statistics Canada, CANSIM Tables 128-0016 and 127-0004

While the figure above provides a snapshot of Ontario's energy use by fuel type in 2011, change is a constant in Ontario's energy industry.

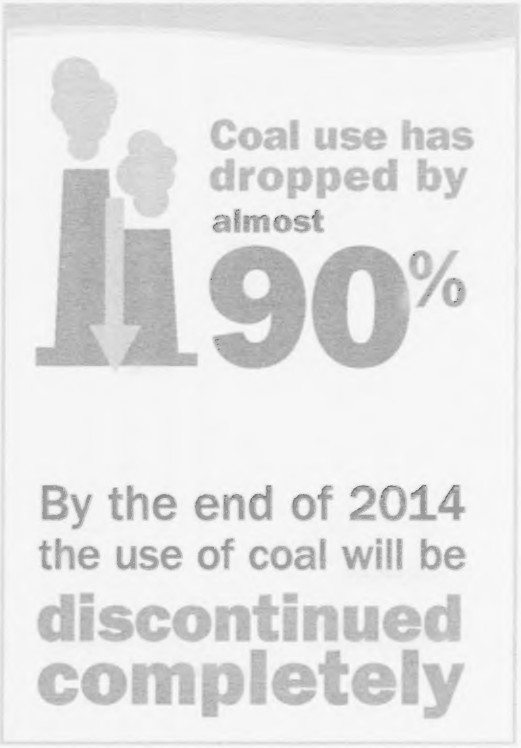
Sixty years ago, Ontario relied on coal-fired generation stations to supply the province's fast-growing electricity needs. In the 1970s, the province turned to nuclear power, building 20 reactors over the following two decades. Then, starting in 2005, the province began to phase out its polluting coal-fired electricity plants and build new renewable and gas-fired generation to replace them. It complemented this with a renewed focus on conservation and energy efficiency.

In addition, the discovery and development of substantial reserves of natural gas in neighbouring U.S. states has brought about fundamental changes both in the price outlook for natural gas and in the sources of Ontario's gas supplies. Significant investments have been undertaken in the network of pipelines that carry gas to Ontario and the changes have affected the oil pipeline network as well.

Ontario's energy plan needs to be continually reviewed and updated to reflect ever-changing conditions. While the government remains committed to a cleaner electricity system that is reliable and cost-effective, it also realizes there is more than one way to achieve this goal. There are choices, and this consultation and engagement process is about giving communities, businesses and ratepayers a say in how to proceed from here.

Where We Are Now

Over the past 10 years, Ontario has made a number of improvements to its electricity system. The province now uses more diverse and complementary sources of energy to provide reliable and affordable electricity, as it's needed.

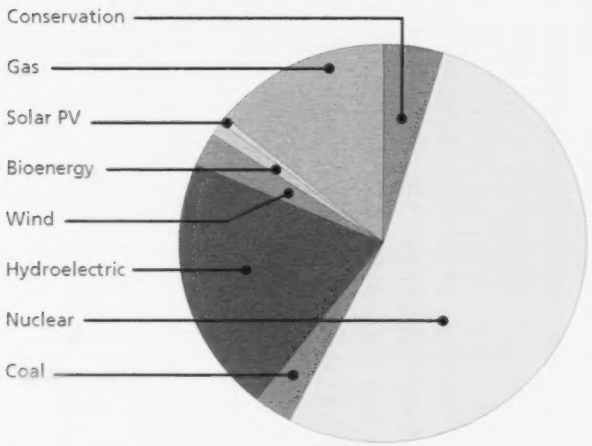


- Since 2003, about 12,000 megawatts (MW) of new and refurbished generation have been added to Ontario's supply portfolio – enough capacity to power the Greater Toronto Area and the city of Ottawa.
- Since 2005, Ontarians have conserved over 1,900MW of power – the equivalent of over 600,000 homes being taken off the grid.
- Ontario has the most solar photovoltaic (PV) capacity of any jurisdiction in Canada with over 700 MW online – enough to power 90,000 homes each year.
- Since 2004, over 3300 MW of renewable power has come online.
- Coal use has dropped by almost 90% since 2003 and Ontario is on track to eliminate coal as a generation source by the end of 2014.
- Over $10 billion has been invested since 2003 in improvements in Hydro One's transmission and distribution systems, including upgrades to over 7,500 kilometres of power lines – more than twice the distance from Sault Ste. Marie, Ontario to Vancouver, B.C.
- Over 4.7 million Ontario consumers now have installed smart meters.
- The third tunnel at Niagara Falls is now operating, marking the successful conclusion of one of the largest renewable energy projects in the world.

Ontario is now in good shape with an ample supply of electricity and an increasing amount of conservation. It's now time to review how we plan to get the energy we will need in the future – the energy that will support our jobs and power our homes.

Figure 2 shows how electricity was generated in Ontario in 2012:

Figure 2: 2012 Generation (TWh)

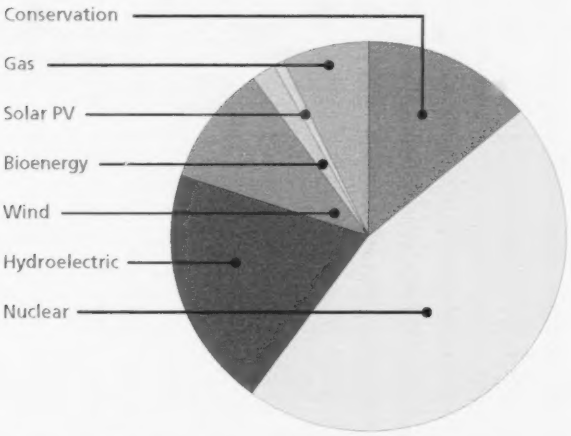


Source	Use	Share
Conservation	7.6 TWh	5%
Gas	22.2 TWh	14%
Solar PV	0.7 TWh	<1%
Bioenergy	1.7 TWh	1%
Wind	5.2 TWh	3%
Hydroelectric	33.8 TWh	21%
Nuclear	85.6 TWh	53%
Coal	4.3 TWh	3%
TOTAL	**161 TWh**	**100%**

Source: Ontario Power Authority, June 2013
Note: Due to rounding, figures do not add up to 100%

Plans for the system 20 years from now will have to be flexible because the energy sector is constantly evolving in response to new developments and technologies. Figure 3 shows what the government thought the future would look like when it released the first Long-Term Energy Plan three years ago.

Figure 3: The supply mix for 2030 as projected in Long-Term Energy Plan 2010



Source	Use	Share
Conservation	27.7 TWh	14%
Gas	13.9 TWh	7%
Solar PV	3 TWh	1.5%
Bioenergy	2.6 TWh	1.3%
Wind	19.8 TWh	10%
Hydroelectric	39.6 TWh	20%
Nuclear	91.1 TWh	46%
Coal	0 TWh	0%
TOTAL	**198 TWh**	**100%**

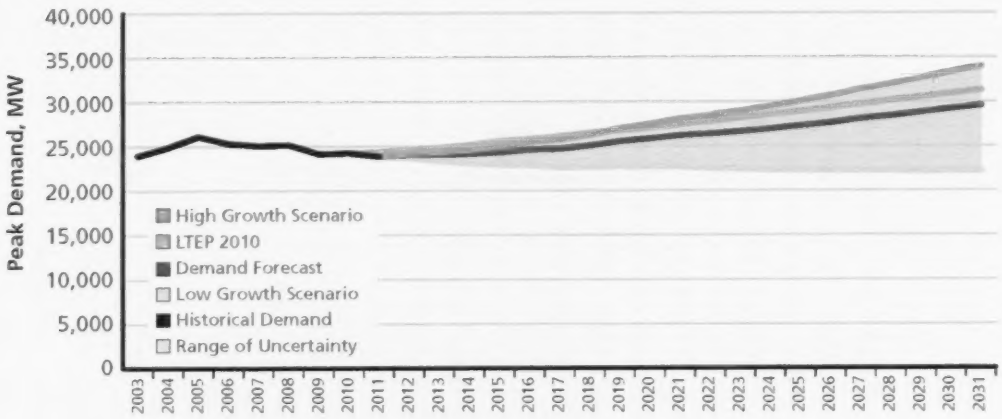
Source: Ontario's Long Term Energy Plan, 2010

The global economy has changed since 2010, and so have our energy needs, which look somewhat different than what was predicted in the 2010 Long-Term Energy Plan. Back then, few foresaw just how commodity prices would change. And few realized the recession would continue to have lingering effects on our economy today.

Some of our major energy consuming industries experienced significant changes in their energy use during the economic downturn. These changes, together with the success of provincial conservation programs, have reduced not only the overall demand for electricity for the past few years, but also the amount of electricity we consume during the peak hours in the summer and winter.

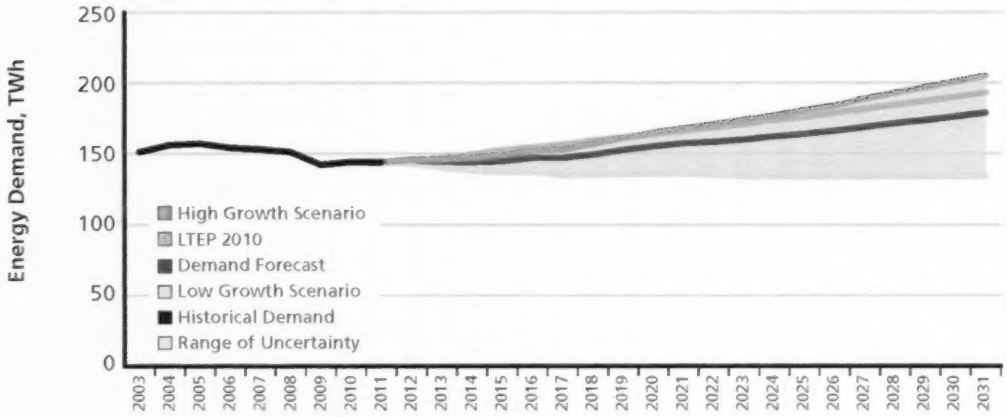
Figures 4a and 4b show the current peak demand forecast and energy demand forecast for electricity. The forecasts include a range of possibilities, reflecting future uncertainties.

Figure 4a: Gross Peak Demand Forecast



Note: Demand Shown is Gross Demand
Source: Ontario Power Authority, June 2013

Figure 4b: Gross Energy Demand Forecast



Note: Demand Shown is Gross Demand
Source: Ontario Power Authority, June 2013

The province's ample supply of electricity has created the perfect opportunity to review Ontario's Long-Term Energy Plan. Much of the province's electricity system that will serve coming generations is already in place, so the choices are more about what can be added and when to add it, in order to provide the additional generation and conservation needed to meet future demand.

Ontario will continue to invest in conservation in order to reduce our supply requirements, nuclear and hydroelectric energy will continue to provide a significant proportion of the province's baseload energy supply, and we will continue to invest in renewable energy and innovation. However, a strong supply situation has created opportunities for changes to Ontario's future supply mix. Through this consultation and engagement process we would like to understand your thoughts on future energy choices.

For Consideration:

How do you think Ontario should balance ratepayer costs, system reliability and GHG emissions when it makes supply mix decisions?

System Reliability and Integration

Ontario's electricity system is complex, requiring skillful and continuous oversight. Not only does power need to be sent over long distances, but it also has to be available exactly when people need it.

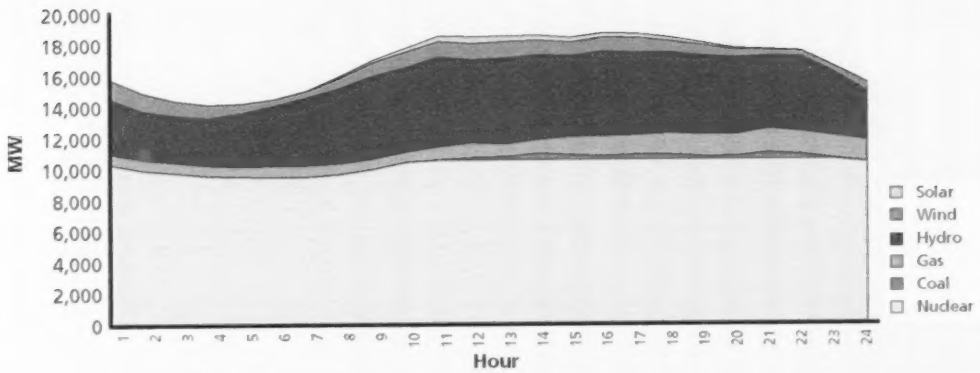
The supply of electricity has to be balanced on a minute-by-minute basis in order to meet demand.

Supply is also not a constant. Ontario must have diverse sources of electricity that can be deployed quickly to ensure people have electricity when they need it.

Any additional supplies of electricity have to match Ontario's demand characteristics, and mandatory North American reliability requirements, such as operating reserves and voltage control.

Electricity demand in Ontario is constantly changing. It's affected by the weather of course, but varies according to the season, the day of the week and the time of day as well. The figure below illustrates the hourly consumption of electricity on a typical day in 2012.

Figure 5: Typical Energy Use by Source



Source: Ministry of Energy, June 2013

Ontario's Electricity Future

Ontario intends to build on its achievements, and ensure the delivery of a clean, reliable and affordable electricity service over the next 20 years.

The province is well served by its diverse portfolio of resources. This supply mix combines conservation with an efficient delivery of generation resources that complement each other.

New electricity generation requires significant investments and the use of natural resources such as land and water, which can have impacts on the environment and surrounding communities. So the first question to be asked is whether some of the future demand for electricity can be eliminated, while we continue to pursue economic growth and prosperity.

Conservation First

In the 2010 Long-Term Energy Plan, Ontario set ambitious goals for conservation. The current conservation efforts focus on three areas:

- **Energy Efficiency** – Setting minimum performance standards that require appliances and equipment to use less electricity; improving building codes; encouraging consumers to participate in energy efficiency programs.
- **Demand Management** – Increasing the ability of homes, industries and businesses to reduce their electricity demand during periods of peak demand, for example, with time-of-use pricing for power.
- **Changing Behaviours** – Helping consumers use electricity efficiently.

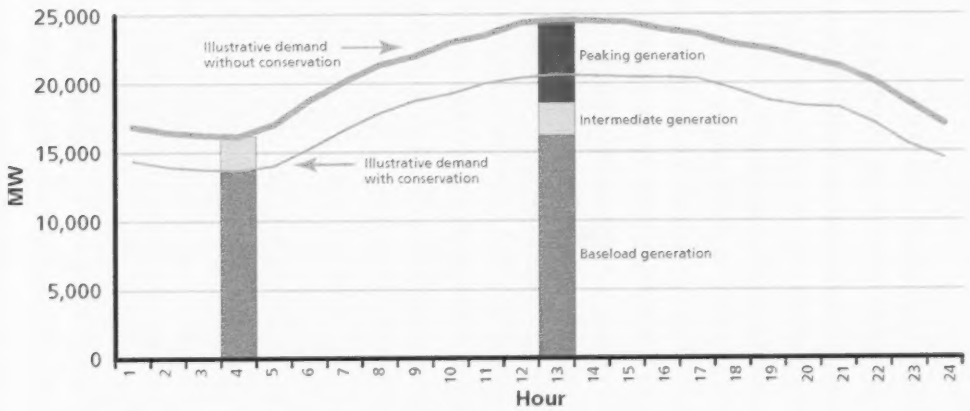
Making a sustained improvement in conservation requires every business and consumer to do significant work. Since 2005, Ontario has saved over 1,900 megawatts of power based on the actions of homeowners, business and industry. That is the equivalent of more than 600,000 homes being taken off the grid. Conservation has not been without its share of challenges. Conservation programs, which require extensive coordination, public awareness and delivery methods, experienced unexpected delays in their implementation.

The government is putting conservation first in our planning, recognizing that it is as valuable a resource as generation. Conservation has been less expensive than building new generation and transmission. And it could reduce much of the future growth in energy demand that is currently predicted for the province.

There are many opportunities for additional cost-effective conservation in Ontario. How much we conserve will depend on a number of factors, such as increasing awareness, offering programs tailored to meet the needs of different customers, unleashing innovation and continuing to aggressively improve the energy efficiency of products through setting minimum efficiency standards.

Conservation plays an important role now and should play an even more critical role going forward, helping to meet the electricity needs that will emerge when nuclear plants start coming offline to be refurbished. During that period of reduced supply, conservation could be used as a cost-effective way to help reduce demand. This in turn would reduce the use of natural gas generating plants, and decrease the emissions of the greenhouse gases (GHGs) the plants produce.

Figure 6: Illustrating the impact of conservation on electricity usage over a day



Source: Ontario Power Authority, June 2013

Demand Management

Demand management initiatives (including demand response) encourage industrial, commercial and residential customers to reduce or shift their electricity use away from peak periods to help avoid the cost of adding new generation for periods where the system is stressed.

Demand management plays an important role in lowering the overall costs of the electricity system and allows businesses in Ontario to be more competitive. It could also be utilized to meet regional reliability requirements and help better integrate renewables into our system.

Ontario currently has about 2% of its peak capacity under contract for demand reduction which can be dispatched when needed. Some believe there is significant potential for wider use.

Conservation can have an additional role, depending on where we live and work. Some regions may need additional supply to meet their electricity needs, which can sometimes require building new generating plants or erecting transmission lines and transformer stations, for example. Energy efficiency and demand response can also play a role in decreasing the need for capital-intensive infrastructure solutions where possible. Each of these options can be evaluated through integrated planning that looks at cost-effective options to meet a region's needs.

A fuller discussion of Ontario's conservation opportunities can be found in the discussion paper, *Conservation First*, to be released Summer 2013 by the Ministry of Energy. Please refer to http://www.ontario.ca/energy for more information.

For consideration:

Should Ontario adjust and/or broaden its conservation goals, in light of current demand and supply forecasts?

How can Ontario maximize its demand management potential?

Nuclear

Because of its reliability, safety, and zero GHG emissions, the government is committed to ensuring that nuclear energy provides a significant portion of Ontario's electricity generation.

When the Long-Term Energy Plan was published in 2010, the province thought it would need to refurbish 10,000 MW of nuclear capacity at the Darlington and Bruce Generating stations, and build approximately 2,000 MW of new nuclear generation at Darlington. However, lower demand growth and strong conservation policies have given the province a chance to revisit its nuclear plans, and examine whether they can be carried out over a longer period of time.

In order to maintain flexible, cost-effective options, the government has contracted with two reactor vendors to develop detailed cost estimates, schedules and plans for the possible construction of two nuclear units at Darlington.

In June 2013, each vendor provided detailed reports, which will be reviewed and used to help determine the preferred option for baseload generation.

At the same time, the government is working on an integrated plan for refurbishing its nuclear fleet. The refurbishing of the Darlington units is scheduled to begin in late 2016. The government has also endorsed Ontario Power Generation (OPG)'s plan, subject to Canadian Nuclear Safety Commission license approval, to continue the operation of the Pickering units to 2020, after which they will be decommissioned.

Of the remaining nuclear fleet, two Bruce units were refurbished and returned to service in late 2012. Refurbishment of the six remaining units need to be considered in the context of the Long-Term Energy Plan.

Slowing the pace of nuclear refurbishment will limit the need for replacement power, reducing some of the expected increases in electricity prices in the near term, although potentially extending the period of surplus baseload generation. Under the existing rate making framework the capital cost of projects such as nuclear refurbishment or new build do not begin to be recovered from customers in rates until the project is in service.

If the need for new build nuclear or alternative baseload generation options is moved out for several years, some of the rate pressures foreseen in the 2010 Long-Term Energy Plan would be shifted from the early 2020s to later in the decade. Whatever option is chosen, the development of an integrated fleet refurbishment schedule will be carried out through careful balancing of the reliability of the electricity system, human and capital resource availability and the economics and availability of alternative supply sources.

For consideration:

Nuclear power provides over half of Ontario's generation. What are your views on refurbishing existing nuclear units?

How should we proceed with nuclear new build?

Natural Gas

When the first Long-Term Energy Plan was released in 2010, it predicted natural gas would only be used for specific purposes. The 2010 Long-Term Energy Plan said it would be used strategically to:

- Complement the supply from renewables such as wind and solar;
- Fill unexpected and temporary reductions in both local and provincial supply; and
- Ensure adequate generation is available when nuclear plants are taken offline and modernized.

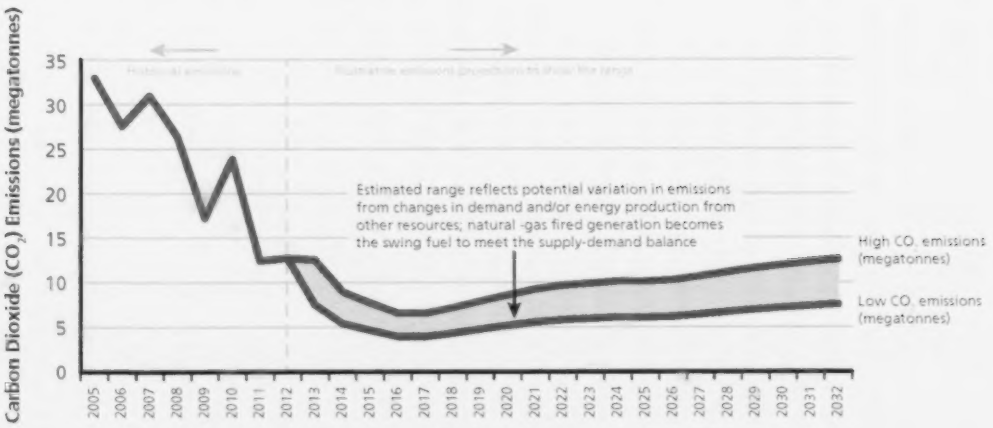
Natural gas is ideal for these purposes because it can be easily "dispatched," which means plants can be fired up quickly to produce electricity and meet demand. Since 2003, Ontario has brought more than 5,000 MW of natural gas generation online in Ontario.

Reviewing the Long-Term Energy Plan gives us an opportunity to consider whether the role of natural gas should change in the coming years. The current natural gas power plant fleet has the capability to generate more electricity when other sources are in short supply – for example, during nuclear outages or if water levels for hydroelectricity are low.

Over the next decade or so, natural gas could be used as additional baseload generation. The 2010 Long-Term Energy Plan suggested it could fill the supply need that's expected to occur when Ontario's nuclear plants start being refurbished in 2016. But this increase in natural gas generation would impact the province's GHG emissions.

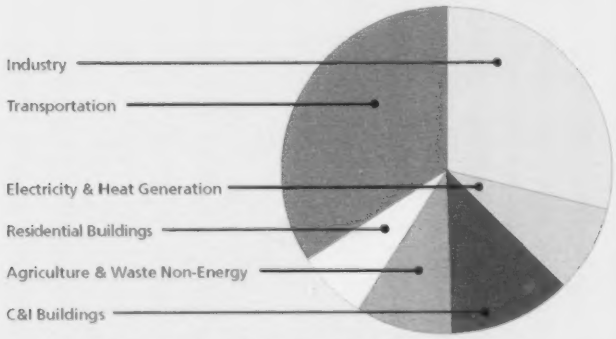
Figure 7 illustrates two possible GHG emission scenarios. The lower end of the range illustrates the increase in GHGs if Ontario meets its projected energy demands with new nuclear. The higher end of the range illustrates how GHG emissions could increase if Ontario uses only natural gas to meets its projected energy demand. There are a broad range of scenarios which could include more conservation and clean imports.

Figure 7: GHG Emission Ranges



Did you know that GHG emissions in Ontario from the generation of electricity and heat contributed to less than 10% of Ontario's total GHG emissions?

Figure 8: 2011 Ontario GHG Emissions By Sector



Source	Share
Industry	29.1%
Transportation	34.1%
Electricity & Heat Generation	8.7%
Residential Buildings	11.7%
Agriculture & Waste Non-Energy	9.6%
C&I Buildings	6.9%
TOTAL	**100%**

Source: Environment Canada, National Inventory Report 1990–2011: Greenhouse Gas Sources and Sinks in Canada (Ottawa, 2013), Part 3, p. 23, Table A11-12

Note: "Electricity and heat generation" comprises emissions from the combustion of fuel in utility thermal power plants. This category does not include emissions from some industrial cogeneration, which are included in the combustion emissions of whichever industry the facility belongs to.

For consideration:

What further role should natural gas play in Ontario's supply mix?

Combined Heat and Power (CHP)

In Combined Heat and Power (CHP) generation, the heat remaining from the electricity generation process is captured and used to produce steam, hot water or other heated fluids that can then be used for industrial, commercial and agricultural heating or cooling purposes. Alternatively, waste energy from industrial processes can be recovered and used to generate electricity.

CHP can reduce emissions and the amount of fuel consumed when compared to separate processes for generation and heating. Since 2005 Ontario has invested in more than 500 MW of new CHP capacity in industries such as steel and pulp mills, vegetable and floral greenhouses and municipal district energy systems.

Ontario remains committed to CHP as an important part of Ontario's electricity supply mix. However, these projects have proven to be complex and each one is unique. We have learned that in general, CHP projects work better if they are driven primarily by the need for heat, with electricity as a by-product. As well as being acceptable to their host communities, CHP projects need to be the right size, in the right location and at the right price to ensure good management of the electricity system, in addition to serving the needs of their heat loads.

For consideration:

What is the best way to assess CHP to ensure generation is developed where it is specifically needed, meets system needs and maximizes value to electricity ratepayers and to heat customers?

Renewable Energy

Renewables: Wind, Solar and Bioenergy

Since 2004, Ontario has made significant investments in renewable energy. We have brought close to 3,000 MW of renewable energy sources online including solar, wind and bioenergy. This is expected to produce enough electricity each year to power more than 700,000 homes.

The government stands firm in its commitment to renewable energy. A cleaner energy system is essential for the future of our children.

Ontario is also committed to creating a stable, predictable procurement process for renewable energy. The government is making 900 MW of new capacity available, between now and 2018, for the Small Feed-in Tarriff (FIT) and microFIT programs. This fall, the Ontario Power Authority (OPA) will open a new procurement window of 70 MW for Small FIT and 30 MW for microFIT. Starting in 2014, annual procurement targets will be set at 150 MW for Small FIT and 50 MW for microFIT. These measures are expected to create 6,400 jobs and produce enough electricity each year for more than 125,000 homes.

Ontario is also increasing local control over future renewable energy projects. A competitive procurement process for renewable projects over 500 kilowatts will replace the existing large project stream of the Feed-In Tariff program and better meet the needs of communities. It will require energy planners and developers to work directly with municipalities to identify appropriate locations and site requirements for any future larger renewable energy project. The OPA and the Independent Electricity System Operator (IESO) are holding regional consultations over the summer of 2013 on the criteria that should be used to more formally engage municipalities in siting new, large energy generation developments.

The IESO is also implementing new rules to efficiently integrate the growing amount of renewable generation. These rules could save ratepayers up to $200 million a year.

For consideration:

Looking beyond 2018, what goal should Ontario set to ensure that non-hydro renewable energy continues to play an important role in meeting Ontario's supply needs?

What innovative strategies and technologies could Ontario pursue in order to further develop and better integrate renewable energy generation into the system?

Hydroelectric

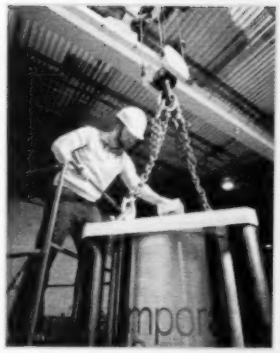
Ontario has a long history of tapping into the significant potential of waterpower across the province. The bulk of our renewable energy supply comes from hydroelectric facilities, which continue to supply over 20% of the province's electricity. Existing hydro is the lowest cost form of generation in Ontario, and in many cases, can help meet peak power demand. Ontario currently has well over 8,000 MW of waterpower in service and has contracting under way to meet our target of 9,000 MW of installed hydroelectric capacity by 2018.

Many hydroelectric stations can rapidly increase or decrease generation to help meet peak demand and assist in the minute-to-minute control of the electricity system. The response of each facility is based on design, location and the amount of water available. The diversity in operational flexibility allows some hydroelectric stations to function as a baseload plant, like a nuclear facility, while others can operate as peaking plants, similar to a gas plant, but with much lower emissions.

For consideration:

Should Ontario pursue further expansion of hydroelectric capacity?

Energy Storage



Energy storage has significant potential to help Ontario modernize its electricity system. It could address the unexpected surpluses and variations in output that come with cleaner, less flexible sources of generation.

A wide variety of energy storage technologies can help address these issues:

- Large-scale energy storage systems (like the Sir Adam Beck pumped hydro station in Niagara or compressed air) could help manage surpluses, storing electricity when we don't need it and bringing it to times when we do. This would reduce our need for gas-fired peak generation and its associated GHG emissions;
- Fast-response flywheels can help system operators with voltage control, and manage minute-by-minute variations in supply and demand. Battery storage systems can help utilities integrate renewable resources, bypassing congested power lines and reducing system losses by satisfying more demand from local sources; and
- Consumers with their own solar panels can reduce their reliance on the wider electricity system by storing any surpluses they generate for times when the sun doesn't shine. One day you may even be able to use your electric vehicle for this purpose!

Much work remains to be done to determine energy storage's real value to Ontario. As it is an emerging technology, many solutions require more testing and development. Like all technologies, energy storage must strive to meet a level of commercialization where the benefits will exceed the costs of building and operating the new infrastructure. Luckily, Ontario is home to a number of emerging, innovative energy storage companies that are working hard to address these challenges and realize this technology's potential.

A number of jurisdictions are looking at storage as an option. The United States is funding a large number of demonstration projects. Closer to home, Alberta Innovates Energy and Environment Solutions is funding research into storage opportunities in the Alberta market, while Dalhousie University in Nova Scotia operates a Renewable Energy Storage Laboratory.

Energy storage is an exciting prospect that will become ever more valuable as we integrate new resources and strive for greater efficiencies.

For consideration:

What role should storage play in meeting Ontario's future energy needs and how should it be valued?

Regional Energy Needs

While demand in Ontario is expected to grow moderately in the next decade, certain regions like the GTA or the North of Dryden area may experience more significant growth.

Urban areas, such as the York Region or Kitchener-Waterloo-Cambridge-Guelph, are faced with significant energy growth due to an increase in residential dwellings and commercial activity. Energy use in Toronto's downtown core is expected to increase because of high-rise development and expanded commercial opportunities. In Ontario's northwest, it is not residential intensification that is leading to new needs, but rather increased mining activity that might do so. However, in each of these situations, regional demands are distinct from province-wide needs – and they need to be evaluated and addressed separately.

These issues are typically handled through regional planning, which is being led by our agencies, the Ontario Power Authority (OPA) and the Independent Electricity System Operation (IESO), through an improved planning framework. This involves looking at an area's needs and evaluating how best to address them given the options available. Conservation, local generation, transmission and other resources can be used to meet local requirements.

Regional planning is being conducted in several areas; e.g., Central-Downtown Toronto, Kitchener-Waterloo-Cambridge-Guelph, York Region, Ottawa and the North of Dryden area.

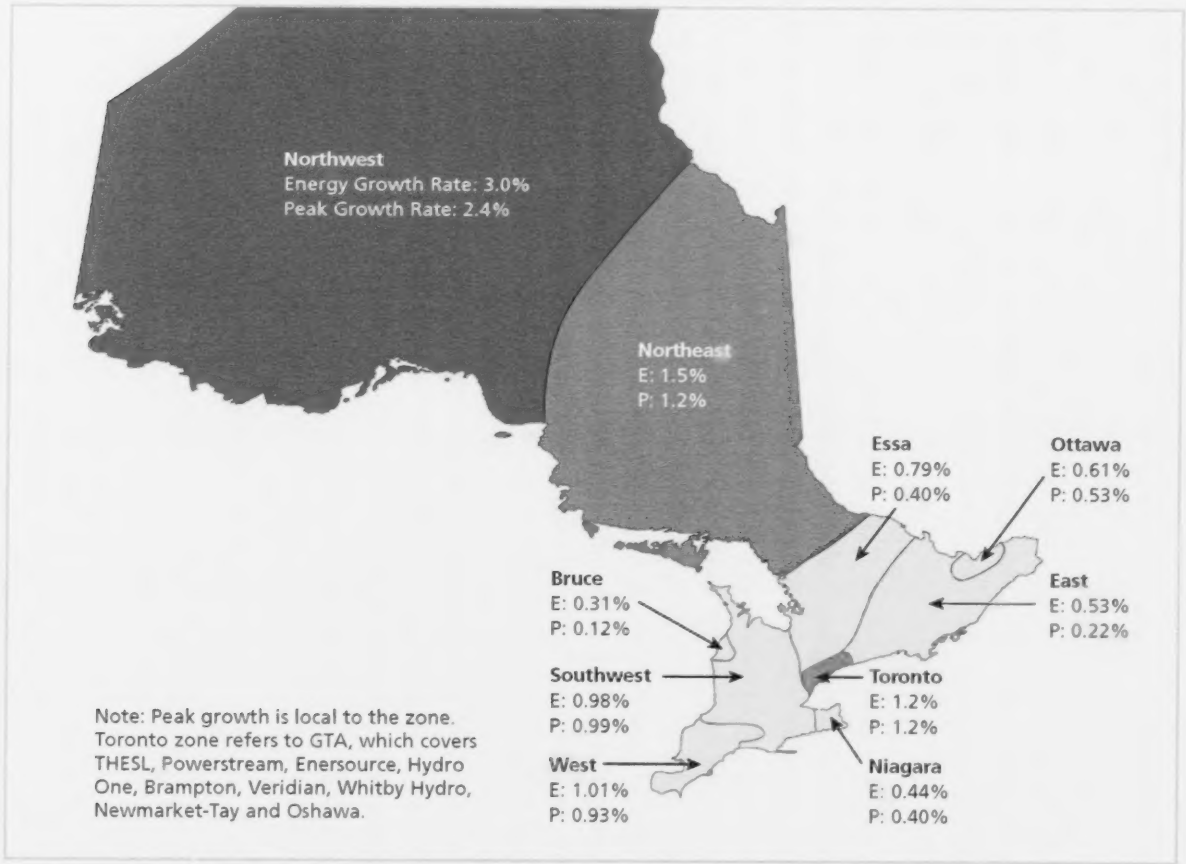
Ontario's Long-Term Energy Plan provides an opportunity to look at how we determine and implement the best regional solutions. The government understands that it is more likely to engage communities and create support if it considers community priorities alongside traditional criteria such as cost-effectiveness and system benefits. Community priorities could include benefits such as energy efficiency, local economic development, social impacts or other community interests.

While a careful eye needs to be given to the balance between the distribution of benefits and the allocation of costs, the addition of other considerations and benefits can improve the way regions add needed electricity infrastructure and resources.

For consideration:

What kinds of local and electricity system benefits as well as broader economic, environmental and community benefits should be considered when selecting and implementing options to meet regional needs?

Figure 9: Annual Gross Demand Growth Rates for 2011-2031 Peak and Energy



Source: Ontario Power Authority, June 2013

Transmission Planning

Ontario is already upgrading its transmission system to meet future growth and accommodate the changing supply mix. The recently completed Bruce to Milton transmission line – Ontario's largest transmission project in 20 years – is a clear example of transmission built to incorporate new and refurbished clean power sources.

The 2010 Long-Term Energy Plan identified additional priority transmission projects to support new renewables, meet changing demand and enhance reliability.

We now have an opportunity to reassess those transmission priorities, at the same time as we review our energy goals and the means to achieve them. It is also a time to evaluate if additional transmission is required to meet new goals or system needs, including any transmission we might need to take advantage of imports.

Figure 10: Ontario's Transmission Grid

Source: Independent Electricity System Operator, June 2013

Significant economic development is anticipated for Northwestern Ontario, which could put pressure on the electricity system. Several new mining projects are being proposed west of Thunder Bay and in the Ring of Fire. These projects represent large and complex economic investments that depend on strong international demand for natural resources.

The OPA is currently evaluating the northwest system in light of these changing conditions. With input from stakeholders, it is developing demand forecasts, as well as looking at what today's system can handle.

The OPA is preparing a report on the area "North of Dryden," a specific pocket of the northwest where new mines could create significant demand. This report will outline possible transmission needs and options that customers – chiefly mines – can use to meet demand in the Pickle Lake and Red Lake areas. It will also examine various demand scenarios and the supply alternatives for supplying the Ring of Fire with electricity.

The OPA is also working with a committee of First Nation representatives to finalize a report on connecting remote communities to the electricity grid. There are 25 remote First Nation communities in Northwest Ontario with local distribution systems that currently rely on expensive, difficult to transport diesel fuel to generate their electricity supply. Many of the current systems also have limited capacity to power their communities, limiting options for community economic development.

A core part of this technical report is looking at the long-term economics of transmission connection and the benefits to the parties who fund the systems, including the federal government. Connection of remote communities will require securing significant contributions from the federal government which, along with the province and the First Nations themselves, will be a major beneficiary. According to the analysis done so far, transmission connections would be significantly less expensive, over the long-term, for the majority of remote First Nation communities than the continued use of diesel fuel. These studies will help identify opportunities for a robust yet flexible electricity plan for Ontario's northwest.

For consideration:

What transmission projects should be considered priorities and why?

How should Ontario work with the federal government to support development of transmission projects to connect remote First Nation communities, including any required enhancements to the existing system?

How should Ontario evaluate whether to expand transmission to take advantage of imports and other opportunities?

Innovation

It used to be said that Thomas Edison could easily understand today's electricity system, because it hasn't really changed much since he invented the light bulb and electricity distribution. The same can't be said for Alexander Graham Bell. The smart phone and the services it can deliver are fundamentally different from the phone that Bell first invented. But with the Smart Grid, soon there will not be much left for Edison to recognize. Today's electricity system is poised on the edge of a period of revolutionary change that could transform how we use electricity, and possibly transform our lives as well.

Smart Grid

New "intelligent" technologies are changing the way power is generated, delivered, and consumed. The "Smart Grid" includes a wide array of technologies that make new sources of information available to consumers and utilities so they can make smart energy decisions remotely and automatically. Utilities, for instance, use fault and theft detection and isolation systems to detect and address outages, either by quickly rerouting power or by preventing the outage altogether.

Visualization of a Smart Grid

The movement towards a "Smart Grid" is a global trend, but one where Ontario utilities are leading by example. By expanding the ability of utilities to plan and respond in real-time to changing system conditions, we use our resources more efficiently, increase reliability, and keep costs down.

Following a successful rollout, smart meters are now helping Ontario consumers control and manage their electricity use. The province's Information and Privacy Commissioner has hailed Ontario's Smart Meter as the "Gold Standard" for considering privacy at all stages of its implementation. Further work is being done on new technologies that encrypt and secure data transfers and prevent malicious attacks on the system. This ensures the province responds appropriately to the growing challenge of cyber-security, keeping consumers' data safe and protecting the integrity of our vital infrastructure.

All regulated transmission and distribution utilities in Ontario must now develop Smart Grid plans, outlining how they will test and adopt new technologies in order to protect consumer privacy and improve the reliability and security of their systems.

Smart Grid Fund

In 2011, the Ontario government launched the Smart Grid Fund, a $50-million program that funds real-world technology projects developed by local companies. To date the Fund has supported over 600 jobs and encouraged partners to invest over $7 for every $1 invested by the government.

- Energate is developing tools that make it easier for consumers to monitor and manage their home energy use and costs. Energate's software, mobile applications, and devices – like smart thermostats and in-home energy displays – also help to manage the system by reducing peak demand.

- Essex Energy Corp. is developing software to integrate data sources from a variety of technologies, including smart meters, to monitor the state of the electricity distribution system and alert operators to system problems.

- On July 2, 2013 the government launched a call for new Ontario-based Smart Grid Fund projects that test, develop and bring to market the next generation of smart grid solutions including advanced energy technology projects, such as energy storage, microgrids and electric vehicle integration.

Access to Data and Green Button

Modern technologies are giving consumers unprecedented information and control over their electricity consumption. Today's homes are beginning to change into the "Smart Homes" of the future, which will use computerized intelligence to automatically manage energy demand based on consumer preferences. Users will be able to control their heating and air conditioning with a smartphone app, or charge their electric vehicle overnight.

As these technologies develop, the Ministry's "Green Button" program will ensure that consumers have access to their electricity data in a safe, secure format that adheres to stringent privacy standards. The data can be used with "Green Button" applications or services to meet consumers' needs and further drive conservation.

For consideration:

Which technology and smart grid innovations do you believe could offer you the greatest benefit to your community and the system as a whole?

Aboriginal Participation

Ontario's electricity system has undergone a great deal of change over the last decade. The province's transmission system has been strengthened, the supply mix has become more diverse, and renewable energy has grown to be a hallmark of Ontario's energy policy. These changes have brought new and exciting economic opportunities to many Ontarians.

Over this same period the government has moved to enhance its relationship with Aboriginal peoples across the province by supporting and encouraging the economic development of First Nation and Métis communities. This has been a key element of Ontario's energy plan and has resulted in a range of policies and programs that increase Aboriginal participation in the energy sector:

- Partnerships and participation in renewable energy projects under the Feed-in Tariff program;
- Programs that build capacity and provide funding assistance, including the Aboriginal Renewable Energy Fund and the Aboriginal Loan Guarantee Program;
- Targeted conservation programming for Aboriginal communities; and
- The promotion of commercial partnerships between transmitters and Aboriginal communities on new major transmission lines.

Many of these initiatives have resulted in rewarding and innovative partnerships between First Nation and Métis communities and energy developers. Others are empowering Aboriginal communities to take control of their own energy needs and interests. As we update Ontario's Long-Term Energy Plan, it is important that our policy to support Aboriginal community participation in the energy sector both continues and evolves. To do this, we must look to Aboriginal communities and key partners to share their interests and provide the ideas and guidance that will strengthen how we implement this policy.

For consideration:

Looking forward, what are the most important tools to support Aboriginal community participation in Ontario's energy sector?

Ontario's Natural Gas And Oil Sectors

Natural Gas

Natural gas accounts for approximately one-third of Ontario's primary energy use and is a widely used fuel in the residential, commercial, industrial, and electricity generation sectors.

Provincial natural gas demand is about 2.8 billion cubic feet (bcf) per day.

The breakdown among the different sectors is as follows:

The vast majority of natural gas is delivered to customers by two local distribution companies (LDCs): Enbridge Gas Distribution and Union Gas. Enbridge provides service to over 2 million customers located primarily in the GTA, Niagara and Ottawa. Union provides serves to approximately 1.4 million customers in more than 400 communities across northern, south western, and eastern Ontario.

Demand Type	Billions of Cubic Feet per day	%
Residential & Commercial	1.62	57%
Industrial	0.74	26%
Electricity Generation	0.47	17%

Residential and commercial demand is primarily for space and water heating purposes and peaks in the winter months.

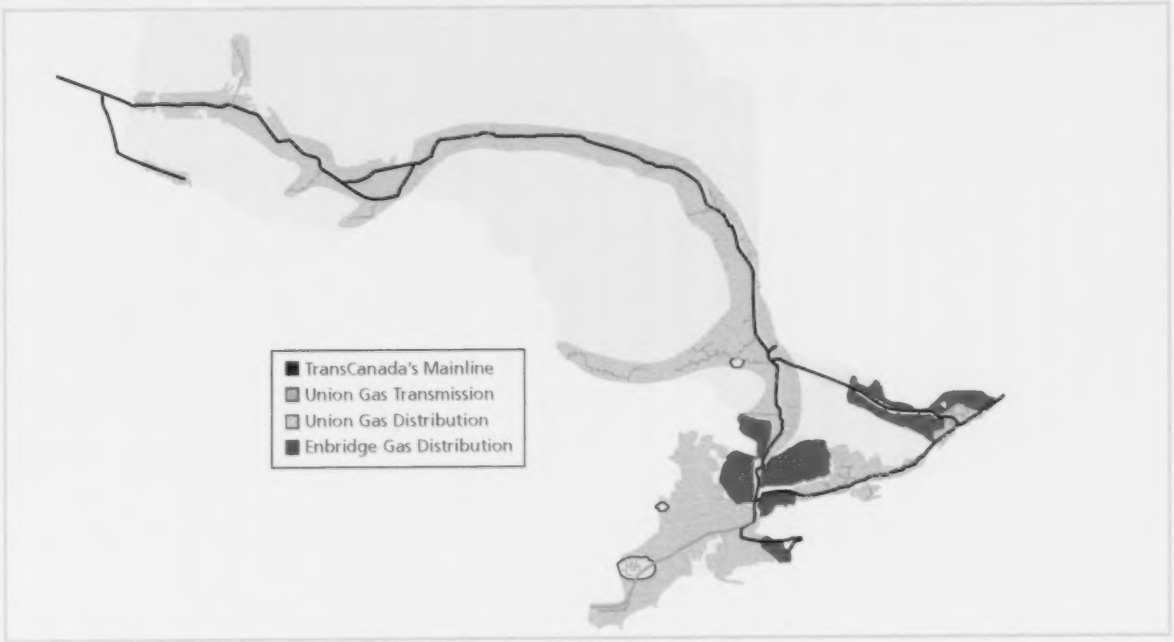
Large industrial users of natural gas include the following sectors: pulp and paper, metal manufacturing, petroleum refining, chemicals, plastics, and food processing. Natural gas fired electricity generation with an installed capacity of 9,987 MW represents 27.9% of the province's total generation capacity.

The Ontario natural gas industry is regulated by the Ontario Energy Board (OEB).The OEB reviews and approves any gas expansion plans by a LDC to extend existing pipelines to service new customers. In making its decision the OEB holds public hearings, and considers economic viability, environmental feasibility and environmental impacts.

Ontario's domestic natural gas production is 23 million cubic feet per day, or about 0.8% of demand. Consequently, transmission pipelines are required to transport natural gas from producing areas of North America – such as the Western Canadian Sedimentary Basin or, more recently, the Marcellus and Utica shale plays in the north eastern United States – into Ontario. Interprovincial pipelines and pipelines connecting with the United States are regulated by the federal government through the National Energy Board.

Ontario is supplied by several pipelines and producing basins. The TransCanada Mainline, which originates in western Canada, which runs across northern Ontario and then branches at North Bay eastwards towards Quebec and south to the GTA, has long been key to meeting Ontario's natural gas requirements.

Figure 11: Ontario's Natural Gas Transmission Network and Distribution Franchise Areas

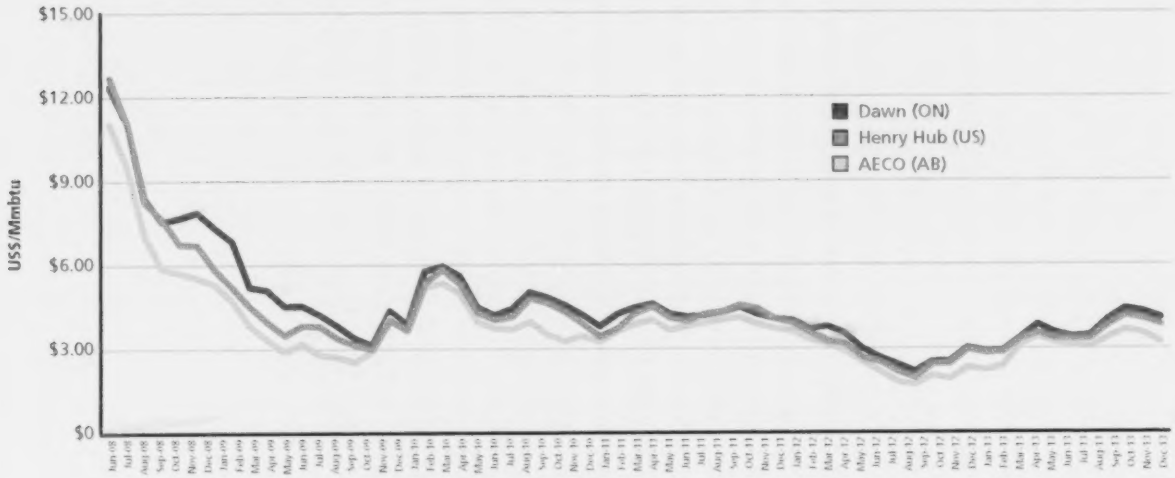


Numerous U.S. pipelines enter southwestern Ontario to access the Dawn natural gas storage hub near Chatham. These pipelines, as part of the complex North American gas pipeline network, can access production from a variety of producing regions of western Canada and U.S. supply basins including the Rockies, mid-continent, and Gulf Coast. Union provides transmission services from its Dawn storage hub into the GTA region where it interconnects with TransCanada's Mainline.

A key change in natural gas markets in recent years has been the emergence of shale gas production. U.S. production of shale gas was negligible a decade ago and now exceeds 25 bcf/d. At present, over 30% of Canadian and U.S. natural gas production is sourced from shaledeposits. The International Energy Agency is estimated that by 2040 over 80% of North American natural gas demand will be supplied from natural gas shale deposits.

The impact of shale gas production on the price of natural gas has been significant. The increasing production of natural gas from shale has contributed to a lowering of the price of natural gas from its peak price of close to $13.00/MMBtu (million British thermal units) at Henry Hub, Louisiana in 2008 to a 14-year low in 2012 at below $2 per MMBtu. Recently natural gas has been trading in the $3-$4 range. Shale gas production capacity together with abundant reserves resulted in the commodity's disconnected from crude oil prices. The historical trading relationship between crude and oil prices was approximately 8:1. Today that ratio is approximately 25:1 with crude oil prices of $100 per barrel.

Figure 12: Monthly Average Natural Gas Spot Prices



Natural gas also has potential for broader application as a transportation fuel given the current wide price disparity with crude oil prices. Natural gas can be used in vehicles as compressed natural gas (CNG) or as liquefied natural gas (LNG). Current efforts are focused on targeting dedicated return-to-base fleets for conversion to natural gas. The future for natural gas as an alternative transportation fuel for major trucking markets is gathering traction in Alberta where a partnership between Shell Canada Ltd. and fuel retailer Pilot Flying J has been established to dispense LNG. Recently, Shell announced their intention to undertake a similar LNG program in Ontario.

Crude Oil, Refined Products and Oil Pipelines

Refined petroleum products including gasoline and diesel fuel satisfy virtually all of Ontario's transportation requirements. Other uses of petroleum products include asphalt production, space heating in communities not served by natural gas, and as an input to the petrochemical sector.

Ontario's domestic sales of petroleum products were 32.9 billion litres in 2012. Provincial demand is met by a combination of Ontario refining capability and imported supplies.

Ontario has four fuel refineries with a combined total crude oil processing capacity of 390,000 barrels per day. This represents approximately 20% of total Canadian refining capacity. In recent years, net imports (primarily from Quebec refiners) have satisfied about one-fifth of provincial demand. The Ontario refineries are:

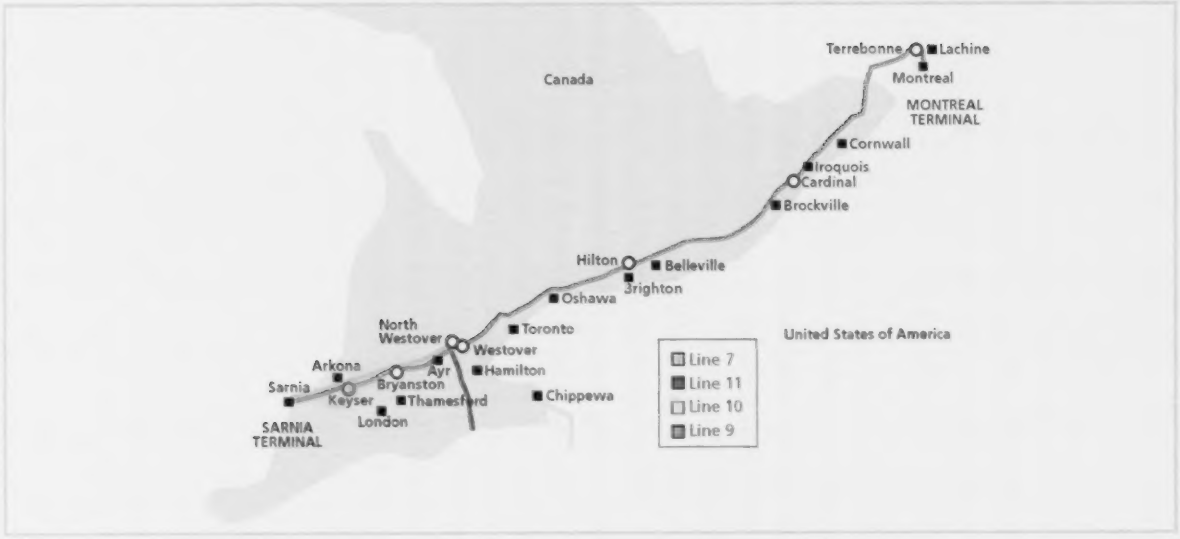
Refinery	Capacity (barrels per day)
Imperial Oil, Sarnia	121,000
Imperial Oil, Nanticoke	112,000
Shell, Sarnia	72,000
Suncor, Sarnia	85,000

Ontario's crude oil production is less than 1,500 barrels per day or 0.4% of the province's refining capability. Consequently, crude oil pipelines are critical to keep Ontario refiners supplied with feedstock. In 2012, over 99.4% of crude oil processed at Ontario refineries was delivered via pipeline. Western Canada was the supply source for 92% of the crude oil processed in the province. The remaining oil was sourced from outside of Canada.

Ontario refiners are supplied with western Canadian crude oil via Enbridge's Line 5 (through Wisconsin) and Enbridge's Line 6 (through Chicago) both into Sarnia. Enbridge facilities in Ontario are then used to transport crude oil from Sarnia to the Imperial Oil Nanticoke refinery and to the border at Niagara for export to refinery in Warren, Pennsylvania.

Since 1999, Enbridge Line 9 enabled the delivery of foreign crude oil to Ontario refiners. Line 9 runs between Sarnia and Montreal. Since 2011, western Canadian crude oil has been considerably cheaper than comparable foreign crude oils.

Figure 13: Enbridge Crude Oil Pipelines in Ontario



Ontario refiners are equipped primarily to process light grades of crude oil. Only the Imperial Oil refinery in Sarnia has a coker, which is specialized equipment needed to convert heavy crude oil into high value finished products such as gasoline and diesel. Conventional light and light synthetic crude oil grades account for about 80% of the crude oil processed at Ontario facilities.

For consideration:

Is there a role for government to work with industry on applications of natural gas such as LNG and CNG?

Should government be working with industry to expand natural gas supply to new communities?

Is the current federal regulatory process sufficient to meet Ontario's needs?

Next Steps

This review is a critical part of the process to establish an updated energy plan for Ontario. The government will take what it learns from these consultation and engagement sessions, along with the advice from its agencies, and use it to formulate its Long-Term Energy Plan.

Please refer to **http://www.ontario.ca/energy** for more information.

Glossary

Baseload Power: Generation sources designed to operate more or less continuously through the day and night and across the seasons of the year. Nuclear and generally large hydro generating stations are examples of generators that operate as baseload generation.

Bioenergy: Energy produced from living or recently living plants or animal sources. Sources for bioenergy generation can include agricultural residues, food-process by-products, animal manure, waste wood and kitchen waste.

Demand Response (DR): Programs designed to adjust the amount of electricity drawn by customers from the grid, in response to changes in the price of electricity during the day, incentive payments and/or other mechanisms. In Ontario, both the OPA and the IESO administer demand response programs.

Dispatchable Generation: Sources of electricity such as natural gas that can be dispatched at the request of power grid operators; that is, output can be increased or decreased as demand or availability of other supply sources changes.

Distribution: A distribution system carries electricity from the transmission system and delivers it to consumers. Typically, the network would include medium-voltage power lines, substations and pole-mounted transformers, low-voltage distribution wiring and electricity meters.

Feed-in Tariff (FIT): A guaranteed rate that provides stable prices through long-term contracts for energy generated using renewable resources.

Greenhouse Gas (GHG): Gas that contributes to the capture of heat in the Earth's atmosphere. Carbon dioxide is the most prominent GHG, in addition to natural sources it is released into the Earth's atmosphere as a result of the burning of fossil fuels such as coal, oil or natural gas. Widely acknowledged as contributing to climate change.

Integration: The way an electricity system combines and delivers various types of generation and conservation in order to ensure consumers have dependable and reliable electricity.

Intermittent Power Generation: Sources of electricity that produce power at varying times, such as wind and solar generators whose output depends on wind speed and solar intensity.

Kilowatt (kW): A standard unit of power that is often used in a residential context, and is equal to 1,000 watts (W). Ten 100-watt light bulbs operated together require one kW of power.

Kilowatt-hour (kWh): A measure of energy production or consumption over time. Ten 100-watt light bulbs, operated together for one hour, consume one kWh of energy.

Load or Demand Management: Measures undertaken to control the level of energy usage at a given time, by increasing or decreasing consumption or shifting consumption to some other time period.

Local Distribution Company (LDC): A utility that owns and operates a distribution system for the local delivery of energy (gas or electricity) to consumers.

Megawatt (MW): A unit of power equal to 1,000 kilowatts (kW) or one million watts (W).

Megawatt-hour (MWh): A measure of energy production or consumption over time: a one MW generator, operating for 24 hours, generates 24 MWh of energy (as does a 24 MW generator, operating for one hour).

MicroFIT: A program that allows Ontario residents to develop a very small or "micro" renewable electricity generation project (10 kilowatts or less in size) on their properties. Under the microFIT Program, they are paid a guaranteed price for all the electricity they produce for at least 20 years.

Peaking Capacity: Generating capacity typically used only to meet the peak demand (highest demand) for electricity during the day; typically provided by hydro, coal or natural gas generators.

Peak Demand: Peak demand, peak load or on-peak are terms describing a period in which electricity is expected to be provided for a sustained period at a significantly higher than average supply level.

Photovoltaic: A technology for converting solar energy into electrical energy (typically by way of photovoltaic cells or panels comprising a number of cells).

Smart Grid: A Smart Grid delivers electricity from suppliers to consumers using digital technology with two-way communications to control appliances at consumers' homes to save energy, reduce costs and increase reliability and transparency.

Supply Mix: The different types of resources that are used to meet electricity demand requirements in a particular jurisdiction. Normally the mix is expressed in terms of the proportion of each type within the overall amount of energy produced.

Terawatt-hour (TWh): A unit of power equal to a billion kilowatt-hours. Ontario's annual electricity consumption in 2013 is around 160 TWh.

Transmission: The movement of electricity, usually over long distance, from generation sites to consumers, or separate local distribution systems. Transmission of electricity is done at high voltages.

© Queen's Printer for Ontario, 2013
Published by the Ministry of Energy
Toronto, Ontario

ISBN: 978-1-4606-2694-8 (Print)
ISBN: 978-1-4606-2695-5 (HTML)
ISBN: 978-1-4606-2696-2 (PDF)

Disponible en français